MASTERING THE MAZE

The BS 6651 British Standard on lightning protection has existed for decades. Now, a new standard, BS EN 62305, has been published for Britain. Compared to the BS 6651's 118 pages, the 475-page BS EN 62305 is daunting. Expanding on an article in the May issue of Electrical Review **John Sherlock** of Furse *(pictured left)*, offers an overview of the new standard and the consolation that, complex as the new standard may be, its key concepts are not alien, and, with relevant technical advice and support, it can be mastered

BS EN 62305 came into force on 1 September 2006. At the moment, it runs concurrently with BS 6651, but ultimately BS 6651 will be withdrawn and BS EN 62305 will be the only recognised standard by the end of August 2008. The new standard consists of four parts:

BS EN 62305-1 : PART 1 GENERAL PRINCIPLES

This is an introduction to the other parts of the standard.

BS EN 62305-2 : PART 2 RISK MANAGEMENT

BS EN 62305-2 specifically deals with making a risk assessment, the results of which define the level of Lightning Protection System (LPS) required. It includes many more parameters than BS 6651 which devotes 9 pages including figures, whilst BS EN 62305-2 contains some 153 pages.

BS EN 62305 contains a series of National Annexes, from which individual countries, like the UK, have used their own interpretation and perception of risk to compile parameters for certain elements of the risk assessment.

The first stage of the risk assessment is to identify the types of loss that a structure and its contents can incur. There are four types of loss defined in BS EN 62305, compared with the one – risk of death/injury – considered in BS 6651.

These risks are:

- R_1 – loss of human life
- R_2 – loss of service to the public
- R_3 – loss of cultural heritage (ie. of historic buildings or monuments)
- R_4 – loss of economic value, considers the cost of the physical loss of equipment. It does not, however, take into account the economic value of consequential losses from system downtime.

Once the applicable types of loss have been identified, a tolerable risk (R_T) for each can be looked up in a table contained in the National Annexes. The actual risk (R) is then arrived at through a series of calculations, using formulae in the standard and including various weighting factors.

If the actual risk (R) is lower than the tolerable risk (R_T), then no protection measures are needed. If R is greater than R_T, then protection measures, as determined from the tables given in the standard, are required. A series of trial and error calculations is then required in order that a sufficient level of lightning protection can be defined. This result decides the choice of Lightning Protection System and Lightning Electro-magnetic Impulse (LEMP) protection system (LPMS).

BS EN 62305-3 : PART 3 PHYSICAL DAMAGE TO STRUCTURES AND LIFE HAZARDS

The third part of the new standard relates directly to the main body of BS 6651, but there are significant differences between the two.

BS EN 62305- defines four Lightning Protection Levels (LPLs) based on probable minimum and maximum lightning currents. These LPLs directly equate to classes of Lightning Protection Systems (LPS).

The new standard uses the class of LPS to define several attributes of the LPS. For example, consider the mesh sizes for an air termination network and spacing of down conductors in BS EN 62305-3:

Class of LPS	Mesh size (m)	Down conductor spacing (m)
I	5 x 5	10
II	10 x 10	10
III	15 x 15	15
IV	20 x 20	20

This compares with BS 6651's two mesh sizes (20m x 10m and 10m x 5m) and two down conductor spacings (10m and 20m).

In BS 6651, a mesh arrangement was the commonly used layout for the air termination network. However, BS EN 62305-3 details the use of air rods or finials, catenary or suspended conductors or a meshed conductor network, in any combination.

The new standard also includes three methods for determining the position of the air termination system:

- The rolling sphere method (whose radius also depends on the class of LPS)
- The protective angle method (a

OF BS EN 62305

mathematical simplification of the rolling sphere method)

- The mesh method

As with BS 6651, the new standard recommends a single integrated earth termination system for a structure. In BS 6651 a system was used where each down conductor was attached to an earth electrode. Whilst BS EN 62305-3 broadly follows this pattern in its Type A arrangement of earth electrodes, it adds a Type B arrangement. This is essentially a ring earth electrode that is sited around the periphery of the structure and is in contact with the earth for at least 80% of its length.

BS EN 62305-3 contains extensive sections, with detailed explanations on the reasons for, and methodology of, equipotential bonding. It requires the bonding of all metallic services to the main equipotential bonding bar. Where the services have 'live' cores, like power or telecommunications cables, then a suitable Surge Protection Device (SPD) should be used.

BS EN 62305-3 expands on BS 6651's data regarding the choice of LPS components and conductors, with tables relating to sizes and types of conductor and earth electrodes. It also specifically requires LPS components to meet the testing regimes defined in the BS EN 50164 standard, where applicable.

BS 6651 recommends the inspection of any LPS annually. BS EN 62305-3 goes further, categorising inspection into visual inspection, complete inspection and critical systems complete inspection, whose frequency depends on the LPL in force.

BS EN 62305-4 : PART 4 ELECTRICAL AND ELECTRONIC SYSTEMS WITHIN STRUCTURES

This part contains one of the most critical differences between the two standards. In BS 6651, the protection of electronic equipment is only included in an informative annex. In BS EN 62305, it is an integral part of the standard - Part 4.

Structural lightning protection cannot now be considered in isolation from transient overvoltage or surge protection. The single risk assessment of Part 2 dictates whether structural and/or Lightning Electromagnetic Impulse (LEMP) protection is required. From that risk assessment, a structure may need both a structural LPS and a fully co-ordinated set of Surge Protection Devices (SPDs) or just overvoltage protection alone.

Whilst BS 6651 recognises a concept of zoning in Annex C (location categories A, B and C), the new standard defines the concept of lightning protection zones (LPZs). This consists of two external zones, LPZ 0A and LPZ 0B, and typically two internal zones, LPZ 1 and LPZ 2. LPZ 0A is exposed to full current and full magnetic field and LPZ 0B to partial/induced current and full magnetic field. LPZ 1 sees limited induced current and damped magnetic field whilst LPZ 2 has a further reduction of induced current and further damped magnetic field. Successive zones are therefore characterised by significant reductions in LEMP severity, achieved through a combination of protection measures such as bonding, shielding and the use of SPDs.

Protection levels within a zone must be co-ordinated with the immunity characteristics of the equipment to be protected, ie, the more sensitive the equipment, the more protected the zone required. The existing fabric and layout of a building may make readily apparent zones, or LPZ techniques may have to be applied to create the required zones.

When applying bonding, shielding and SPDs, technical excellence must be balanced with economic necessity. For new builds, bonding and screening measures can be integrally designed to form part of the complete Lightning Protection Measures System (LPMS). However, for an existing structure, retrofitting a set of co-ordinated SPDs is likely to be the easiest and most cost-effective solution. SPDs also provide additional protection over bonding and shielding measures through protection in both common and differential modes. This ensures equipment is not only protected from damage but also remains operational during lightning activity.

BS EN 62305-4 emphasises the use of co-ordinated SPDs for the protection of equipment. This simply means a series of SPDs whose locations and LEMP handling attributes are co-ordinated in such a way as to protect the equipment in their environment by reducing the LEMP effects to a safe level. So there may be a heavy duty lightning current Type I SPD at the service entrance to handle the majority of the surge energy, plus downstream overvoltage SPDs to protect terminal equipment. Appropriate SPDs should be fitted wherever services cross from one LPZ to another

CONCLUSION

So, this brief overview of the new BS EN 62305 lightning protection standard clearly demonstrates how it is more complex and exacting than its predecessor. However, the key principles are well established and pretty familiar to all. Moreover, established suppliers of lightning protection solutions are now offering a wealth of quality support tools. These include risk assessment software to automate the complex and repetitive risk calculations, new technical literature, training seminars and face-to-face assistance.

BS EN 62305 will take some time for people to fully interpret and comprehend, but by using the resources available, the issues they may initially encounter certainly can be mastered.

John Sherlock sits on the British Standards Institute's GEL81 technical committee for lightning protection, the TC81X lightning protection committee for CENELEC, and the IEC's TC81 technical committee for lightning protection.